RAILWAY ENGINEERING
and Maintenance of Way

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A Monthly Railway Journal

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Communications on any topic suitable to our columns are solicited.
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The Maintenance of Way Painters' Convention

THE officers and Executive Board of the Association of Maintenance of Way, Master Painters of the United States and Canada are now busy preparing for the convention, which is to be held in Cincinnati, Ohio, November 13 and 14. One of the most important things to be done in order to make the convention a success from the educational standpoint, which is the real purpose of the organization, is the selection of suitable subjects for the programme, and every one interested in the roadway, bridge or building, painting of railroads, whether he be a foreman painter, an engineer of maintenance of way, a manufacturer, or even though he have no actual connection with railroad work, is requested to send as early as possible to the secretary, H. J. Schnell, 100 William St., New York City, suggestions for suitable practical subjects for discussion. As is the case with all railroad societies, the primary objects are to secure better work, reduced cost and increased efficiency of the maintenance of way painting department, rather than the individual profit or benefit of the members. This association, then, should appeal to all engineers of maintenance of way, road masters or general superintendents, whatever the officer may be who has charge of bridge building and roadway painting for his company—and they should see to it that their foreman painters attend the coming convention, in order that they may interchange experience with fellow workers in the same line and thereby increase their efficiency to the employing companies. No railroad should object to the small expense incurred in sending the foreman maintenance of way painters to the convention, especially when the experience gained there will undoubtedly increase the efficiency of the painting department and save money to the companies.

Railway Location

ONE of the most convincing evidences of the earnest purpose of the railway organizations to achieve technical results through the deliberative action of trained minds, is seen in the appointment of the standing committee by the executive board of the American Railway Engineering and Maintenance of Way Association in 1904, for the purpose of passing on questions of the greatest import to the railway civil engineer. This committee is known as No. 16, and its work as cut out in the study of the economies of railway location, contemplates the investigation of the theory and practice of location of grades and lines and their effect on operation with reference to all phases of traffic.

The importance of this work is second to none ever attempted by this association, since it involves practically the elements on which was based the admirable work by Wellington and which will always remain one of the most prized tomes of the engineer's library. The thoroughness with which the committee has prepared to approach the details, is manifested in the questions formulated and placed before the members, the replies to which will enable the committee to reflect the ripe experience of the members of the association, in a report that when presented, will have behind it the prestige of that body as a whole. Below are the questions on which information is sought:

1. On new lines or changes of any magnitude in operated lines, are reconnaissance surveys made, the results placed on small map and profile form and approximate estimate obtained, before regular survey force commences work?

2. Enumerate in general the field force and outfit of a complete reconnaissance survey party, also that of regular preliminary and location surveys.

3. Furnish copy of instructions to engineers on preliminary surveys and locations.

4. Are engineers instructed definitely as to limiting grades to be used in each direction, and is the development of future traffic taken into substantial account in considering the present economic value of such grades?

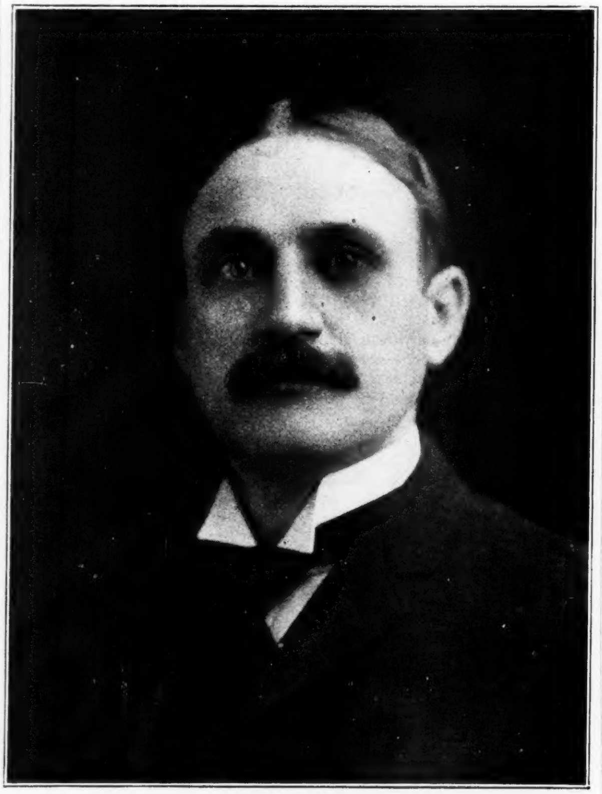
5. If future traffic is taken into account, for how many years in advance should the estimated traffic be adapted?

6. If the outlook for immediate traffic is only moderate, but ultimate future increase probable, is the use

of temporary steep grades over heavy sections advocated, and to what extent if same are to be ultimately used as pusher grades or modified when traffic warrants?

7. Is a temporary line ever built in order to avoid heavy work until the traffic develops sufficiently to warrant the construction of the permanent line?

8. What consideration is given to making a grade somewhat less in rate than the limiting grade, where it can be done without much increased cost in the line, the object being to allow freight trains to make better time than they can do on limiting grades?



MR. HENRY MILLER,
GENERAL MANAGER WABASH RAILROAD.

Mr. Miller was born at Hannibal in 1863; entered railroad service in 1878 with the Hannibal & St. Joseph as boilermaker's apprentice; made switchman in 1879; appointed yardmaster in 1883; appointed trainmaster of the St. Louis, Keokuk & Northwestern line in 1890; promoted to assistant superintendent in May, 1892; promoted to superintendent in May, 1902; promoted to general superintendent of the Missouri lines of the Burlington in January, 1903; promoted to general manager of the Wabash Railroad, May 1, 1905.

9. On new lines, or on work of grade revision, is the use of momentum grades advocated, and to what extent? If so, what is the method of determining the rate and the length of the momentum or steepest actual grade used?

10. Are there diagrams or tables used in arriving at such momentum grades? Please furnish a sample of such, or reference thereto.

11. When reductions in grades on an operated line are contemplated, is the existing traffic taken as a basis on which to figure the number of train miles with a certain weight of locomotive, or how is the number of trains determined?

12. Is it customary to reduce grades at stations, passing points, water stations or tunnels, in order to compensate for starting, and if so, what is the nature of the decrease?

13. At what rate of grade between stations is it considered that tonnage is limited by resistance due to starting or to the necessity of making time?

14. In instructions to engineers, what principles are taken into account in fixing the maximum degree of curvature?

15. Are all grades compensated for curves, or only limiting grades? Is it considered that compensation should be directly proportional to the degree of curve, or should it vary, depending upon the degree of curve? What compensation is considered suitable, and what are the underlying reasons therefor?

16. Is the compensation of a main-line grade for curvature advocated in the turnout to a siding?

17. Are any instructions given relative to fixing the degree or length of curve with reference to the total deflection?

18. Are engineers given definite instructions in regard to values for different increases or decreases in distance, grades, curvature per degree, rise and fall, as well as total elimination of curves and time saved for both passenger and freight trains?

19. What is the nature of such values, and how based?

20. What rate of change in grade per 100 feet is allowed for vertical curves at intersections in sags and on summits, and what change in rate of intersection is considered necessary before vertical curves are used? Please furnish copy of tables used, or reference thereto.

21. What theoretical methods are used for fixing the tonnage rating of locomotives?

22. What is the nature of actual experimental tests? It is desirable to know in as much detail as possible, how the experiments are made, and what observations are taken.

23. At what speed is it considered that the traction of locomotives should be figured? Is this varied in view of the amount and length of limiting grade in an engine run?

24. What methods are used in finding the equivalent values for empty and loaded cars for the purpose of tonnage rating?

25. What is the train resistance, at ten miles per hour, for empty box cars and for loading in box cars for long trains after having run several miles? Does this resistance increase with speed?

Reinforced Concrete Construction--Wabash Railroad

ONE of the live problems which has confronted the bridge engineer since the ballasting of tracks on bridges came to the front as a practice possessing the elements of durability and economy in maintenance of the roadbed itself, is the need of preservation of the steel base supporting the ballast from the deterioration due to want of proper protection. Many schemes have been worked out and applied, with the object of separating the ballast from the steel flooring, all with indifferent results, when reinforced concrete was recommended as an ideal material to interpose between the metal floor of a bridge and the ballast supporting the ties. Such construction is being successfully used on the Wabash R. R., and through the courtesy of Mr. A. O. Cunningham, the bridge engineer of that road, we present several designs, showing application of concrete to through and deck girder bridges, also box culvert and abutment work.

Design A, shown in Fig. 1, is one of the arrangements of standard floor for through girders, having a concrete floor wth an end thickness of 8 inches, which is supported on 15-inch I-beams spaced 18 inches centers. The ties are shown resting on 8 inches of ballast. The reinforcement consists of ½-inch square bars running lengthwise of bridge, located near the underside and spaced 6 inches centers, while another set of bars of the same dimensions and running in the same direction are located under the upper face and are spaced 12 inches centers. The transverse reinforcement consists also of ½-inch square bars spaced at 18 inches centers. Fig. 2 shows Design B, which was also devised for through girders, in which the floor construction differs from the foregoing by surrounding the I-beams with concrete, the ballast being contained in the spacing between the floor beams, which are 12-inch, 50-lbs. and are spaced 20 inch centers.

The ties are shown supported by the ballast between beams, with the underside of tie on line with the concrete covering at top of beam. In this case the concrete reinforcement transversely consists of bars at each side of the floor beams near the bottom flange, with the ends bent up for a distance of two feet. Longitudinally there are no rods passing through the web of the beams spaced at 6 inch centers. In addition to this there is a 1-inch mesh wire netting for the reinforcement of the

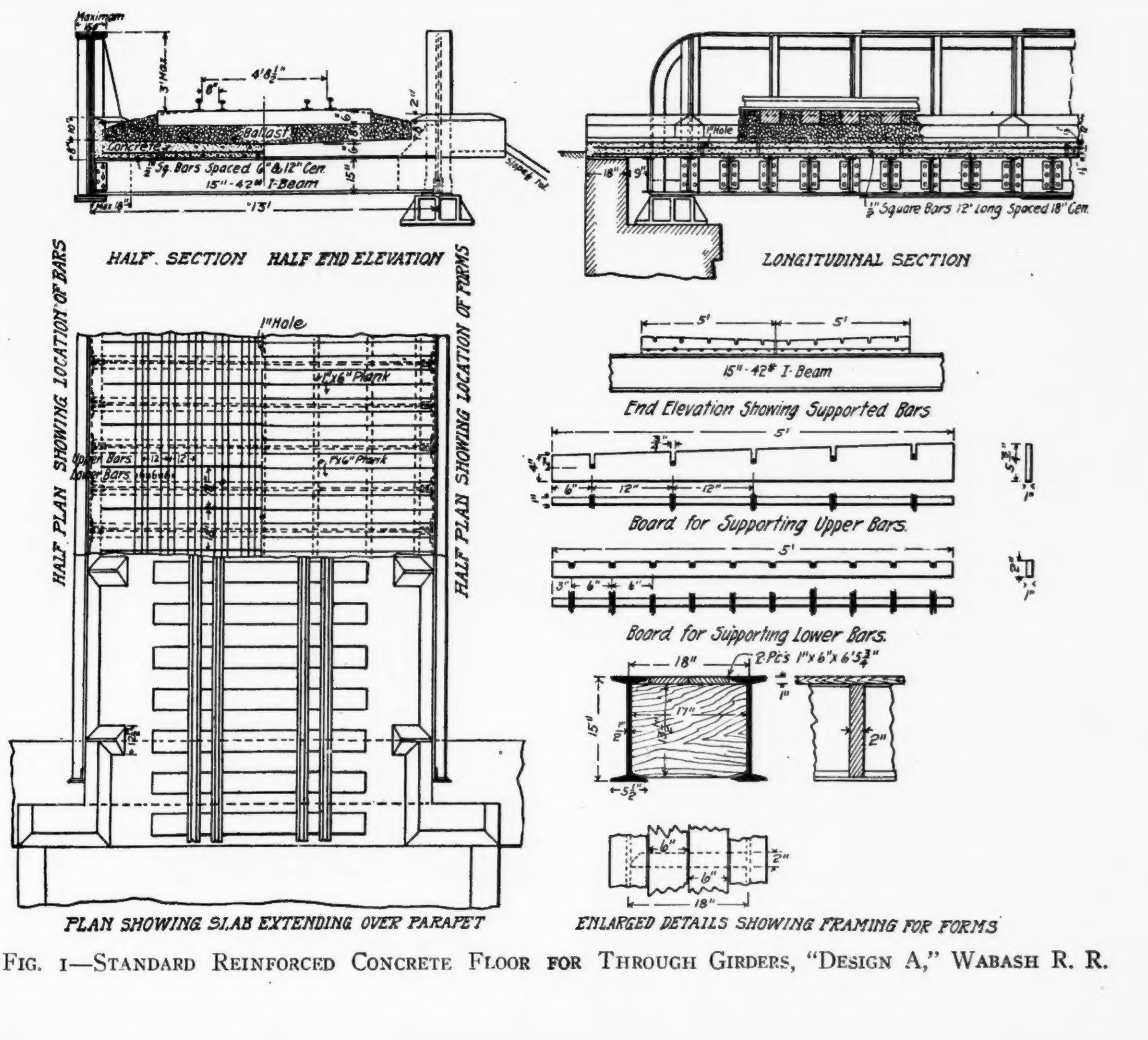


FIG. 1—STANDARD REINFORCED CONCRETE FLOOR FOR THROUGH GIRDERS, "DESIGN A," WABASH R. R.

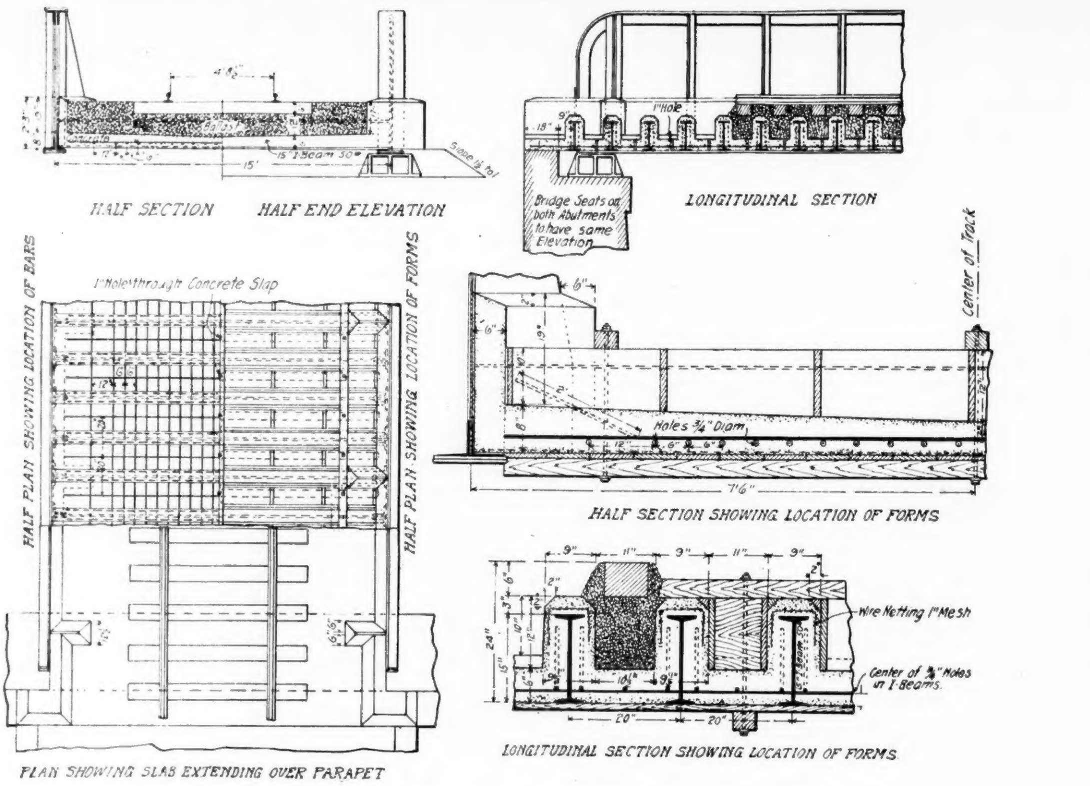


Fig. 2—Standard Reinforced Concrete Floor for Through Girders, "Design B," Wabash R. R.

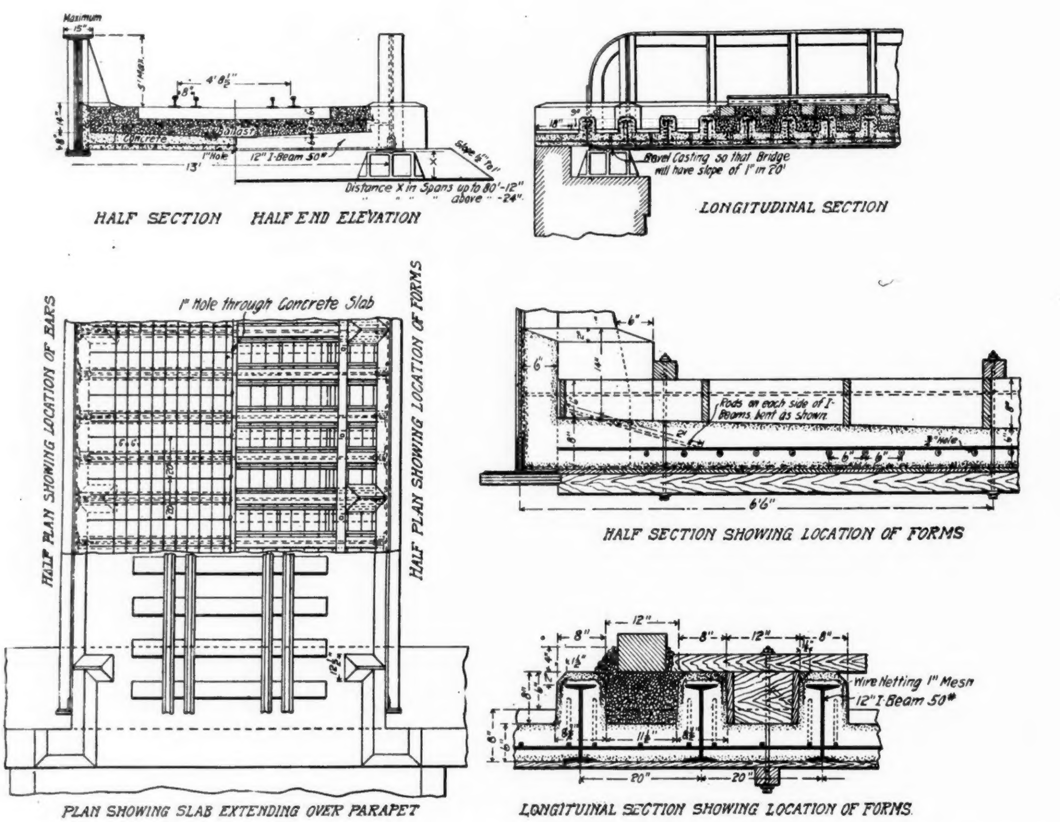


Fig. 3—Standard Reinforced Concrete Floor for Through Girders, "Design C," Wabash R. R.

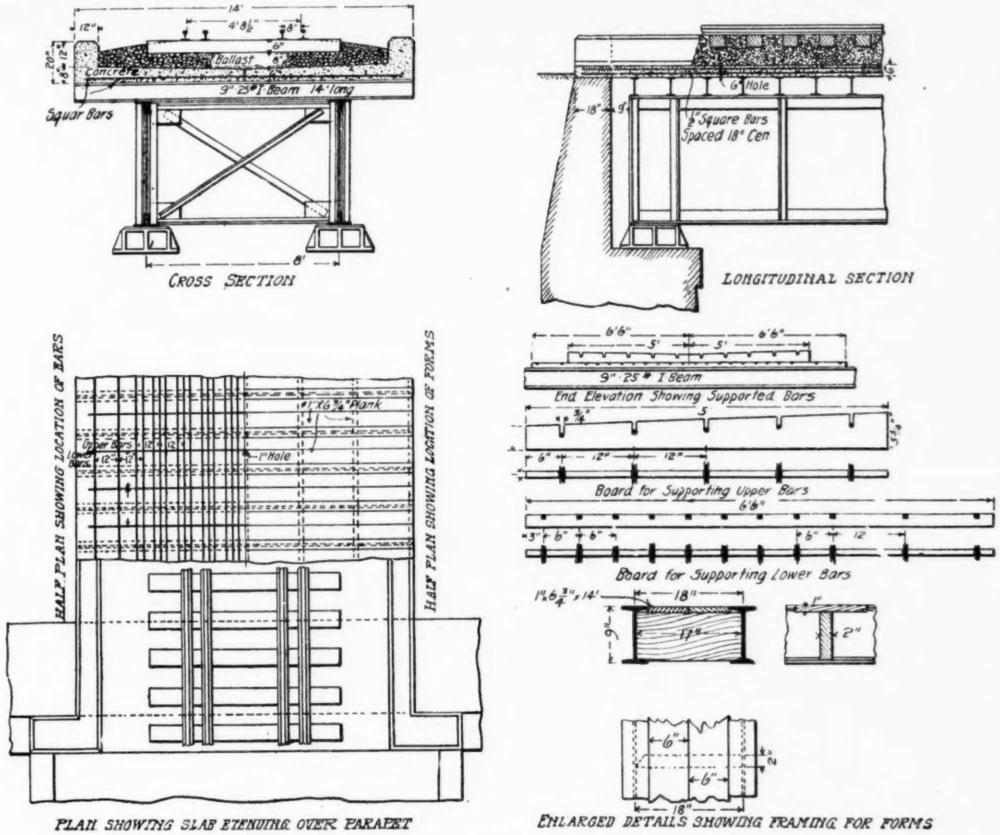


FIG. 4—STANDARD REINFORCED CONCRETE FLOOR FOR DECK GIRDERS, WABASH R. R.

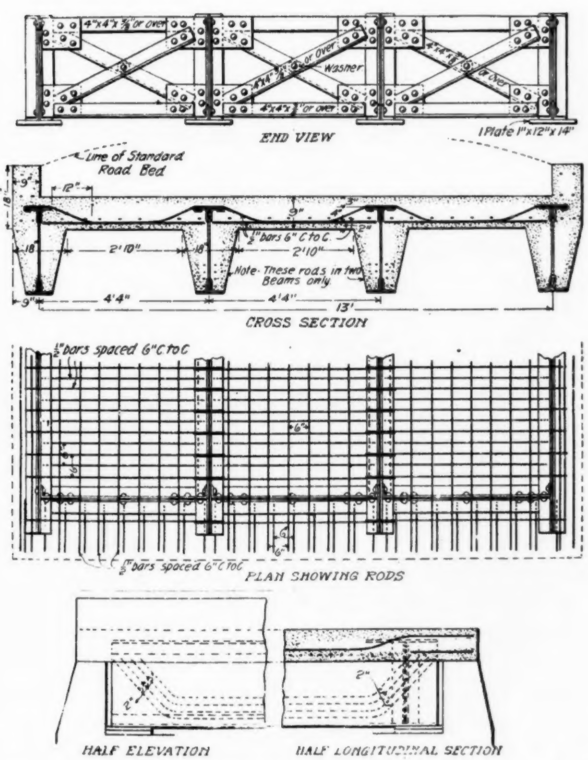


FIG. 5—DESIGN OF REINFORCED CONCRETE FLOOR MADE OF OLD BRIDGE STRINGERS, WABASH R. R.

concrete which covers the top of the beams. This reinforcement is clearly shown in the sectional views.

In Fig. 3 is shown Design C, which is another arrangement for through girders. The principle involved in disposing of the ballast is the same as in Fig. 2, the difference being in details and dimensions, which are apparent in the views. Fig. 4 represents the floor for deck girder bridges, in which the floor is of reinforced concrete 6 inches thick, and has the retaining wall or

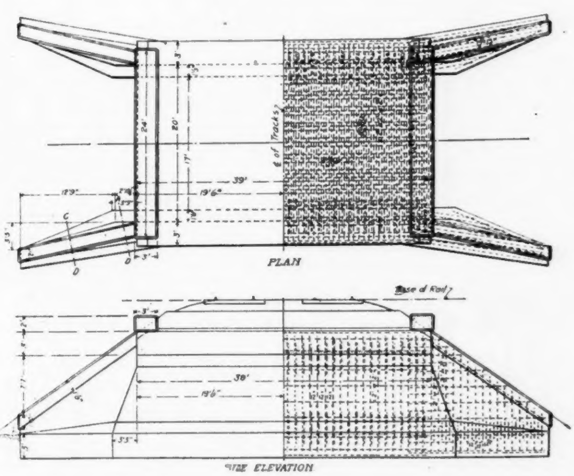


FIG. 7—ARRANGEMENT OF REINFORCING BARS IN CONCRETE BOX CULVERT, WABASH R. R.

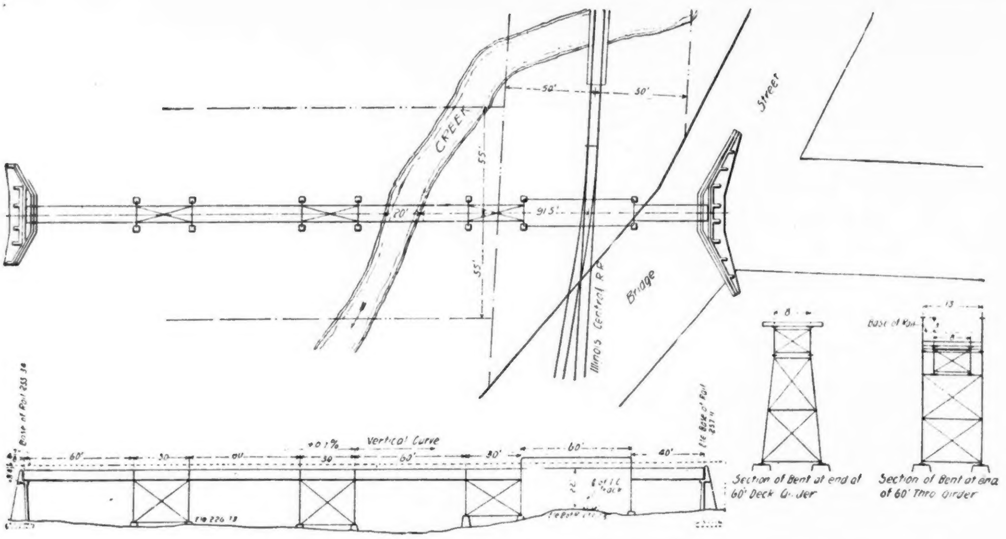


FIG. 8—MAP AND GENERAL ELEVATION OF MONTICELLO VIADUCT, WABASH R. R.

ledge 12 inches thick at the sides to hold the ballast, and which is a feature of this construction worthy of more than passing note. The reinforcement is in the form of bars placed at both bottom and top of the concrete and spaced at 12 inch centers. The I-beams in this case are 9-inch, 25-lbs., and 14 feet long with a center spacing of 18 inches.

The utilization of old bridge stringers as basic elements for a reinforced concrete structure is shown in Fig. 5. The concrete bed is 9 inches thick between the stringers, and entirely surrounds them above the lower angle flanges, and having a thickness of 3 inches over upper flanges. The longitudinal reinforcement is made by ½-inch square bars located 3 inches above the lower surface of concrete, while the transverse reinforcement is by means of rods of same dimensions placed one inch lower down and both spaced 3 inches centers. A novel truss is formed by every second transverse rod passing over the stringers, and being secured to the outermost pair by having the rod ends hooked and engaging with the upper flange of the stringer. This arrangement, as a whole, will be recognized as good engineering in adapting means to an end.

Fig. 6 represents a sectional elevation of a box culvert of reinforced concrete under a wooden trestle. It will be seen to be a clean example of good design and execution. The span is 20 feet and the top of the culvert is of concrete 3 feet thick, with a reinforcement of 1¼-

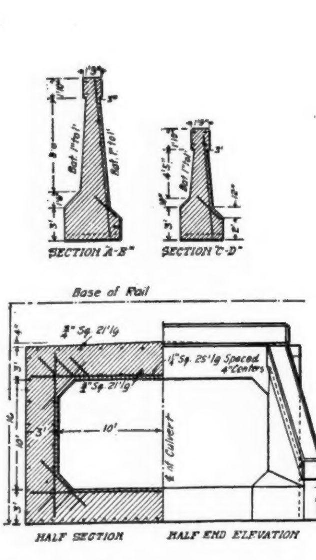


FIG. 6—ELEVATION AND SECTIONAL VIEW OF REINFORCED BOX CULVERT, WABASH R. R.

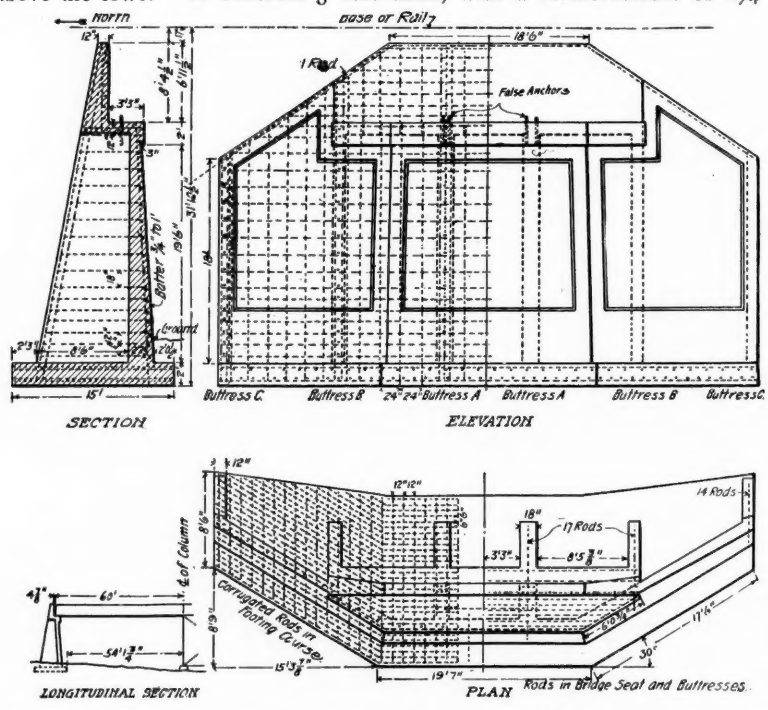


FIG. 9—DETAILS OF REINFORCED CONCRETE ABUTMENT AT NORTH END OF MONTICELLO VIADUCT, WABASH R. R.

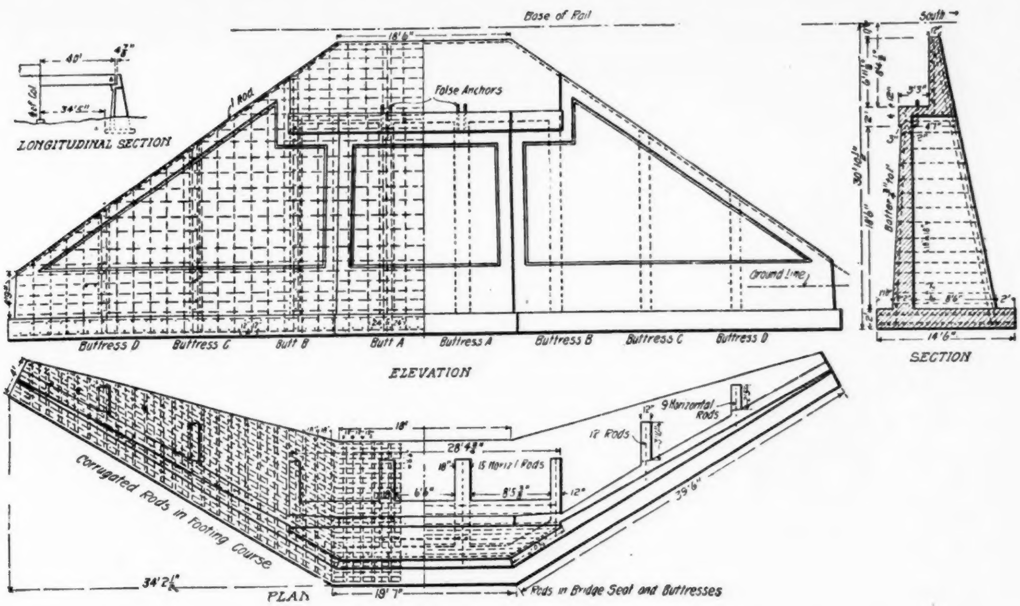


Fig. 10—Details of Reinforced Concrete Abutmentat South End of Monticello Viaduct, Wabash R. R.

inch square bars spaced 8 inches centers, between which are ¾-inch bars with a variable spacing. Transversely there are ¾-inch bars at the top and bottom spaced 24 inches centers, besides which there are diagonal bars of the same size at the corners. Fig. 7 shows an elevation and plan of this culvert in working drawing, in which the method of reinforcing is worked out. In Fig. 8 is seen the plan and elevation of a viaduct having abutments of reinforced concrete. Fig. 9 represents the abutment at the north end of this viaduct, which is 23 feet high from bottom of foundation to the bridge seat and 30 feet 5½ inches to top of the parapet. Fig. 10 shows the south abutment, which is constructed on the same general lines as that at the north end, except in size, both being of the hollow type from question of economy. Both drawings explain the construction and method of reinforcing with the bars near the front face of the abutments, also the relation of solid parts to voids. These examples of concrete construction are interesting in the fact that they show advanced practice in the art, and explain the facility with which concrete may be moulded and literally cut to fit any desired condition.

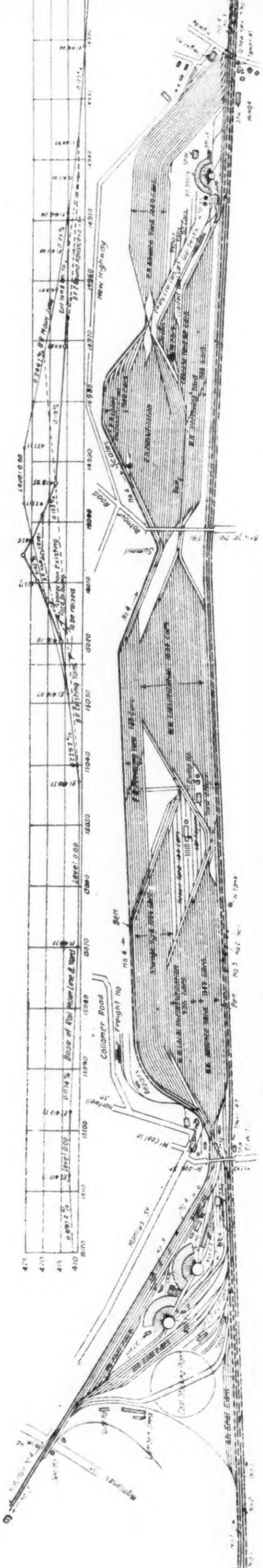
Gravity Yards at Dewitt--New York Central

ONE of the latest and best developments of the gravity or hump yard system of train classification is that installed in the New York Central yards at Dewitt, and which is shown herewith is profile and plan. The point at which this comparatively new method of switching cars into trains is located has for years been the principal distributing yard of the road, and the need for improved processes in handling the immense volume of traffic, brought such a pressure to bear, that the old way was forced to a well earned retirement.

A reference to the illustration will show that the receiving tracks, advance tracks and classification tracks, extend in each direction from the hump. East-bound trains enter the receiving tracqs provided for trains going in that direction, when the engines are detached and reach the engine house by way of the belt line track, after which the cars are pushed over the hump and drop by gravity into the classification yard, after which they are there assembled into trains in the east bound advance yard, the cabooses meanwhile having been cut off to be in readiness for the made up west bound trains.

In like manner the west bound trains enter the receiving tracks for that direction, when the engines leave the trains as before, and return to the engine house, the cars passing over the hump into the classification yard, and are assembled into trains which are placed on the advance tracks. In both these cases repair tracks are conveniently located. These operations above refer to the handling of heavy trains, but the fast express freight trains, of which there are ten or more a day, are also passed through this yard. The east-bound trains are taken directly into the east bound classification tracks for the purpose of changing engines and cabooses, when they are ready to go to destination. The west-bound fast trains are taken directly into the south tracks and having obtained new crews, proceed. No switching is done to these trains other than to remove a car for cause, or to receive cars to fill out.

For east bound traffic, which consists in general of loads, the accelerating grade is 2½ per cent for a distance of 150 feet, and a grade of one per cent for a distance of 1,200 feet through the ladder tracks, the rest of the classification tracks being nearly level. The west bound grades on which are handled many empties, are heavier, owing to the fact that winds are usually against traffic; the accelerating grade being about four per cent for a distance of 150 feet, with a one per cent grade



Gravity Yards at Dewitt, New York Central

for a distance of 1,200 feet, and on the remainder of the classification tracks there is a descending grade of practically 0.25 per cent. The volume of business handled over the hump, averages in each direction, from 1,500 to 2,500 cars per day. The yards were designed to handle about 50 trains in each direction per day of 24 hours, or about 3,500 cars each way.

The Trump Concrete Measuring and Mixing Machine

A MACHINE whose function is not only to mix concrete, but also to accurately measure the amount used, was the subject of a paper read before the American Society of Mechanical Engineers at the meeting recently held at Scranton, Pa., by its inventor, Edw. N. Trump, member, and chief engineer of the Solvay Process Co. The machine, as built by the Link Belt Machinery Co., Philadelphia, is shown in Fig. 1, is which is seen a portable device for performing the operations of proportioning the dry ingredients, also moistening, mixing and delivering them in the form of finished concrete ready to lay.

All of the proportioned ingredients fall costinuously into the machine in proper amounts. The particles in falling become separated from each other, and sprays playing on each side of the thin falling streams reach every particle, thoroughly moistening the mass. A small tank mounted on the machine, and controlled by a float valve, gives a constant and uniform supply of water, this method of wetting absolutely preventing any loss of cement by washing away, and insuring that there are no dry balls of cement, all parts of the mass getting a like amount of water.

The mass, when thus proportioned, mixed and moistened, falls into a trough, where the mixing is completed by a series of paddles mounted on a shaft and driven by the same power that actuates the measuring device. The paddles deliver the concrete at the end of the trough ready to lay. An electric motor is shown on the machine, but the motive power may be gas, gasoline or steam, as desired, and mounted on the frame as in the case of the electric drive, or belt power may be used when necessary.

The measuring device consists of a horizontal revolving table, shown in Fig. 2, on which the material to be measured rests, and a stationary knife set just above the table and pivoted on a vertical shaft just outside the circumference. This knife can be adjusted so as to extend the proper distance into the material on the table, at each revolution of which it peels off a certain amount of the material, which falls over the edge of the table into the chute. As the material is peeled off by the knife it must be replenished, so that the pile on a certain part of the table is filled in to approximately the same shape and size by the time it has revolved, so as to again be presented to the knife. This is accomplished, as shown in Fig 3, by placing a bottomless storage cylinder, somewhat smaller in diameter than the table, with the lower edge a short distance above the table, so that the mate-

rial flows out from under this edge and takes a conical shape as shown.

After deciding upon the distance between the bottom of the cylinder and the table, and the width of the knife, the other factors which determine the amount of material measured off in a given time are the speed of rotation and the depth of cut of the knife—and these are both adjustable. The depth of cut of the knife is adjusted by swinging the knife around on its pivot, so that it extends to a greater or less amount into the material. This swinging action is controlled by a screw attached to an arm, cast as a part of the knife, and a micrometer scale with a pointer shows the amount of movement. This adjusting detail is shown in Fig. 4.

When it is desired to measure off and mix two or more materials, the machines are made with two or more tables, set one above the other, and mounted on the same spindle, so that they revolve together, each table having its own storage cylinder above it, and the cylinders being placed one within the other, as shown in Fig. 5. For each table there is a knife, with its own adjusting mechanism, which allows the user to vary at will, the percentage of each material in a mixture, and, as the materials flow together constantly and regularly in small streams, as they drop down the common chute, each infinitesimal amount of one ingredient is accompanied by the proper amounts of the other ingredients, and the particles intimately mixed.

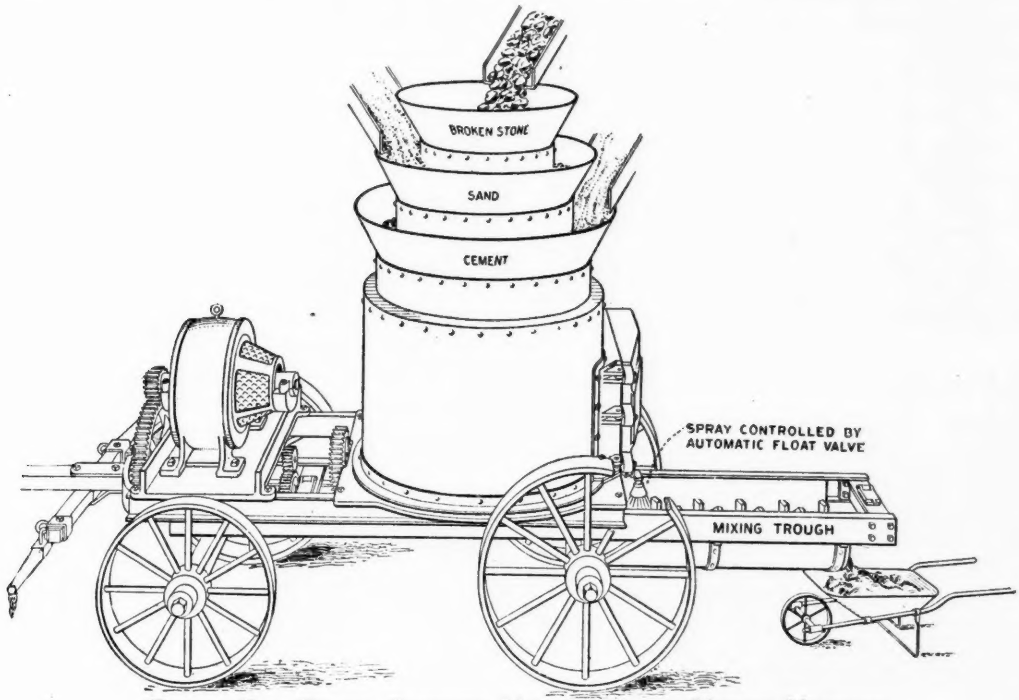


FIG. 1—THE TRUMP CONCRETE MEASURING AND MIXING MACHINE.

In feeding materials to the storage cylinders of these machines, a conveyor can be employer, they can be delivered by gravity from a storage bin, or they can be shoveled, and it is only necessary to see that enough is kept in the storage cylinders so that the amount which the knives peel off will be constant. With some finely powdered materials, which flow very freely, it is necessary to place feeding scales at the top of the storage

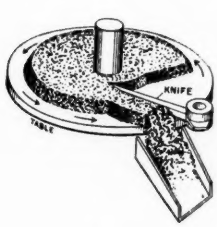


FIG. 2.

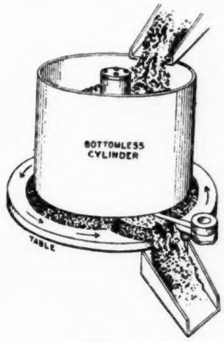


FIG. 3.

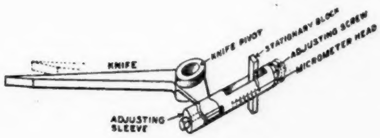


FIG. 4.

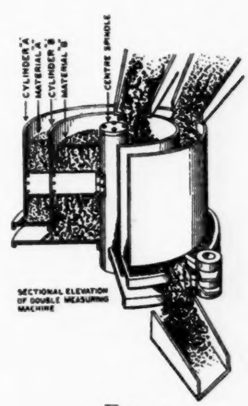


FIG. 5.

cylinders to regulate the density and pressure on the material below, so that it will not pack or flow out at the bottom too rapidly and flood the table.

The tables and storage cylinders are all mounted on and driven by the same center sleeve, which is carried on a dirt-proof step-bearing with hard bronze and steel washers and proper oiling device. The lowest table has a bevel gear cast on the under side, and is driven by a pinion mounted on a countershaft. The casings of the machine are made dust-proof, to avoid any possibility of leakage or pollution of the air by finely powdered materials, and the whole is mounted on a substantial base, thus making the machine entirely self-contained. Its portability enables the machine to follow up such contracts as sewers, reservoirs, conduits and other works of magnitude, with the least possible carrying of concrete, and in small undertakings all the advantages of machine made concrete are had without expense, except that of hauling the outfit to the scene of operations.

New Grand Central Terminal—New York Central

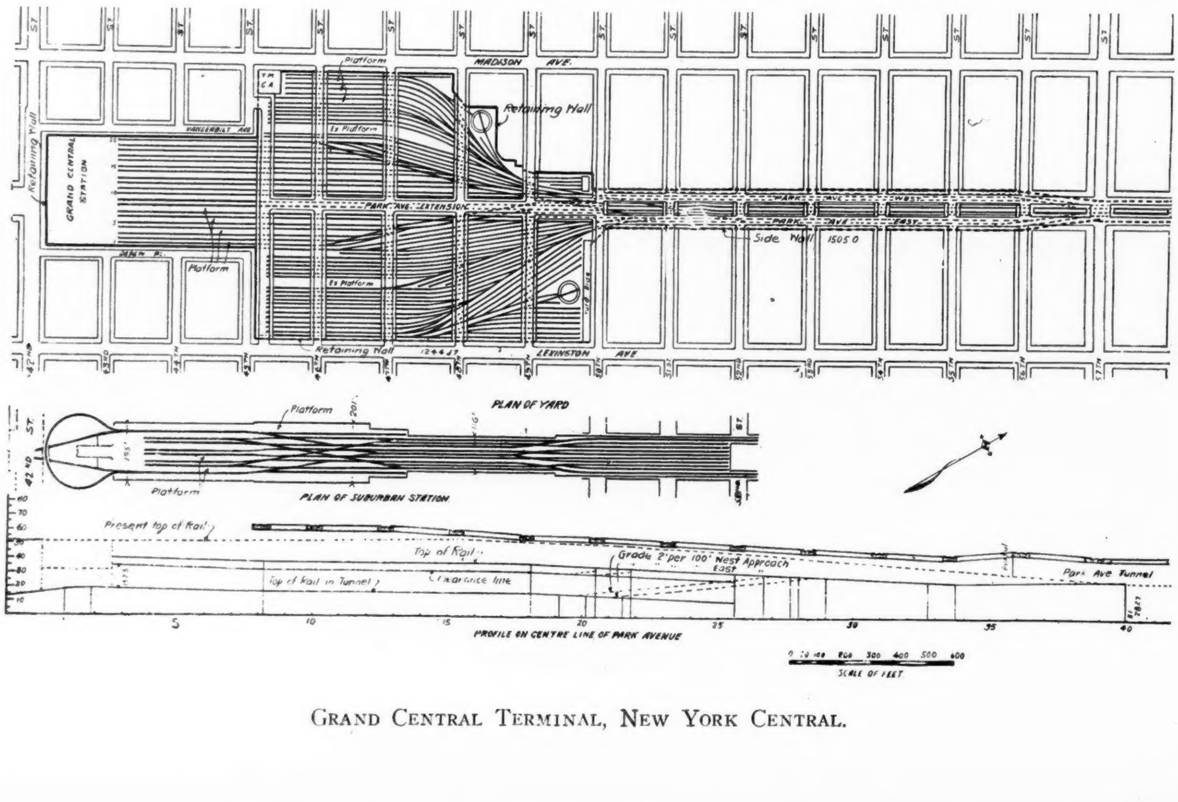
THE scheme of expansion projected by the New York Central for terminal facilities, at and near the site of the present Grand Central station in New York City, will, when carried to completion, give what is intended to be one of the most up-to-date railway stations possible to produce by the untrammeled use of brains and capital. The improvements are apparently planned with the view of a harmonious operation in the electrification of the road and suburban service.

In the illustration, the plan of trackage and yard boundary is shown together with the area covered by the station itself. The plan of the suburban station with its lay-out of tracks and loop is shown under the general plan in its correct relative position thereto. The center line of the latter system of tracks coincides with that of the Park avenue tracks on the general plan, by which connection is made with the Park avenue tunnel from which the tracks terminate in a loop under the Grand Central Station. A profile of the tunnel is shown immediately under the plan of the suburban station, showing the present and proposed gradients.

One of the new features in station architecture that is to be embodied in the new arrangement will be the assignment of rooms for official quarters. In this case no provision whatever is to be made for the accommodation of any one but the patrons of the road. The offices are to be arranged in that part of the structure farthest from the passenger section, entirely distinct and apart from it, and will therefore be unique in terminal practice. The work of excavation from 45th street north is being rapidly prosecuted, but the work is one of such magnitude as to make progress appear slow; it is, however, an engineering proposition that will go to a finish quickly when the preliminary work is well in hand. The company is spending millions of dollars in this improvement work, and aims to have it include the abolition of crossings of streets and highways at grade, whenever it is possible to do so, and especially on the New York Central division to Croton and the Harlem division to White Plains.

Automatic Railway Block Signals—General Electric Company

AMONG the exhibits which attracted the attention of the delegates to the International Railway Congress at Washington, and exacted favorable comment, was the new electrically operated automatic block



GRAND CENTRAL TERMINAL, NEW YORK CENTRAL.

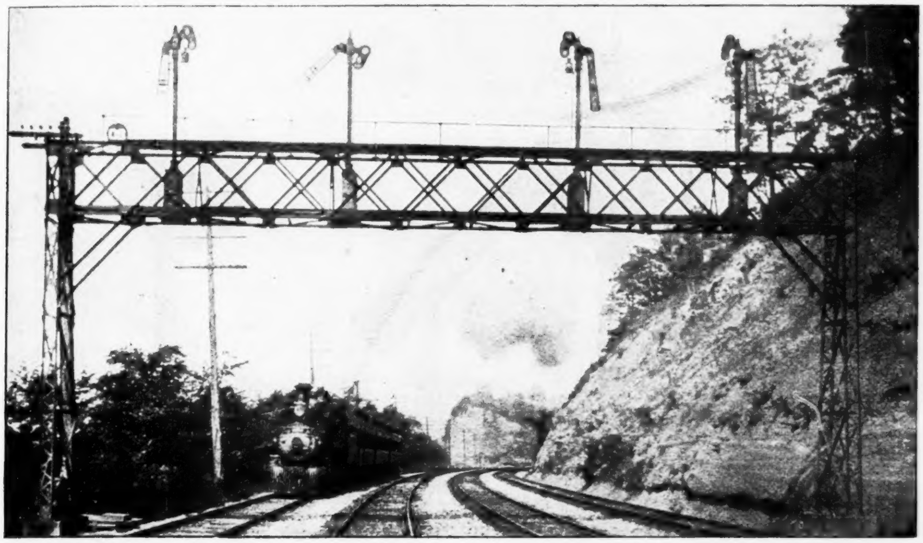


FIG. 1—SIGNALS ON THE PITTSBURG, FT. WAYNE & CHICAGO R. R.

signal system, which was a part of the General Electric exhibit, and making its initial bow to the public on that occasion in a role widely separated from its actua duties as a safety device Its operation, however, was in no wise different in principle from the first installation of the system made on the Pittsburg, Fort Wayne & Chicago Ry., in 1904, a general idea of which may be had from the view of the signals shown in Fig. 1.

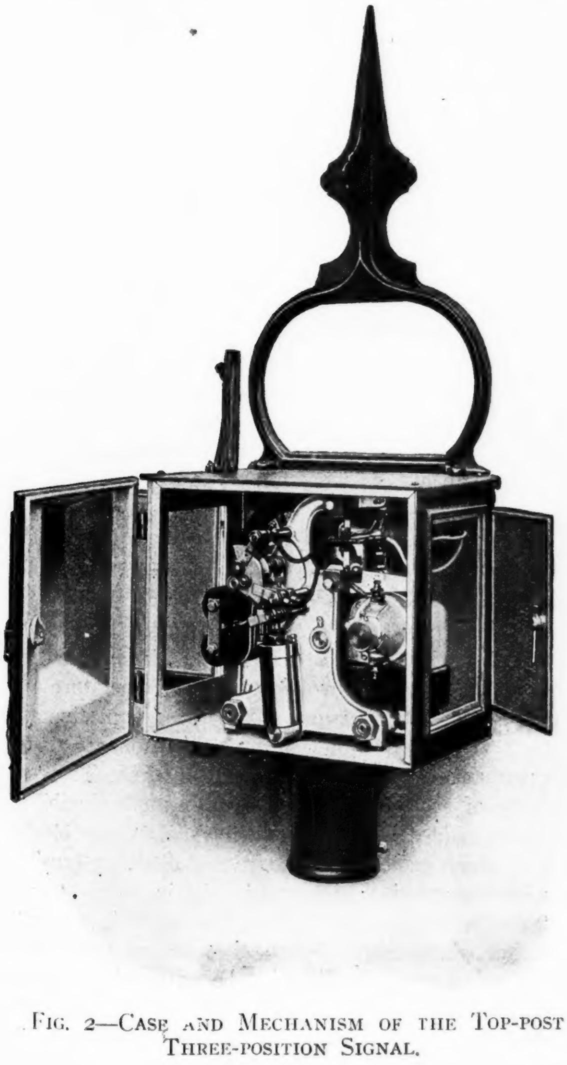


FIG. 2—CASE AND MECHANISM OF THE TOP-POST THREE-POSITION SIGNAL.

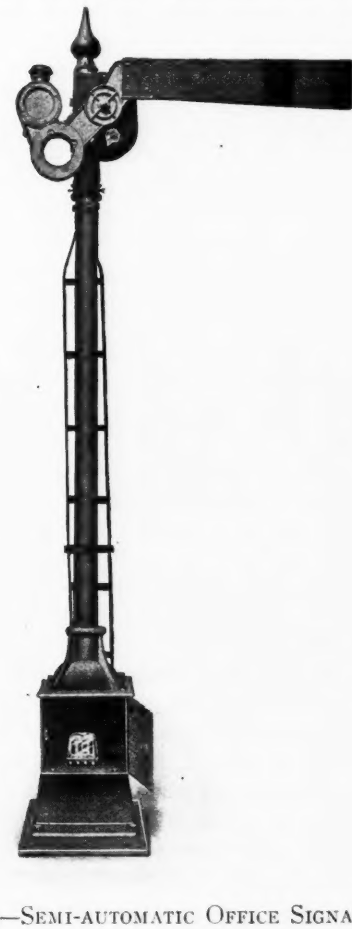
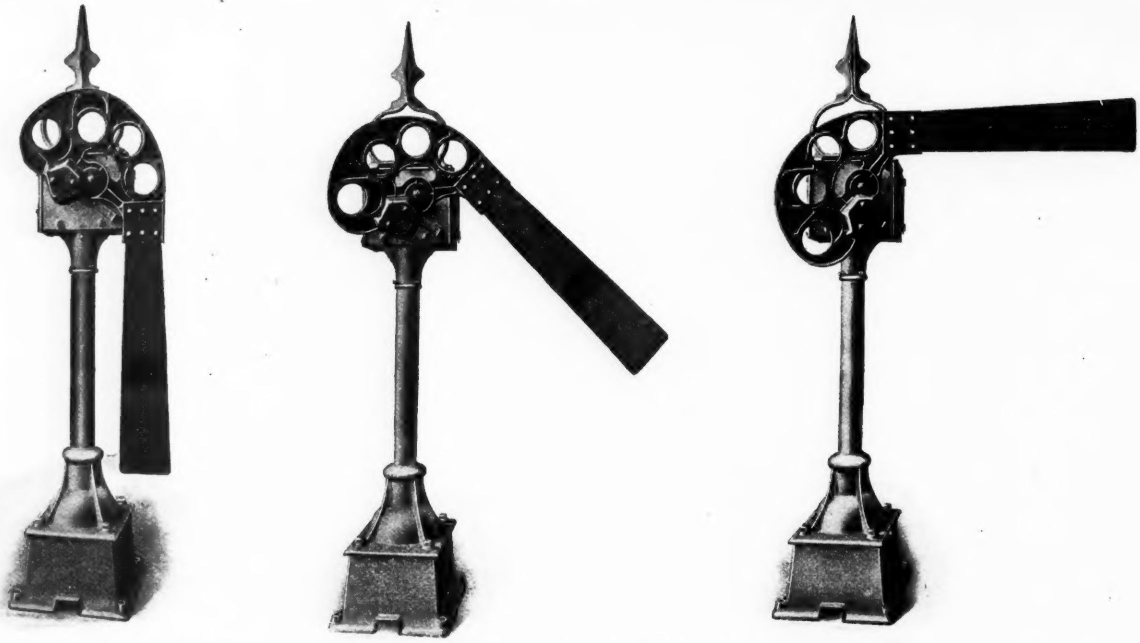


FIG. 9—SEMI-AUTOMATIC OFFICE SIGNAL.



FIGS. 3, 4 AND 5—THE TOP-POST SIGNAL WHICH MADE 74,000 MOVEMENTS WITHOUT RENEWAL OF BATTERY.

This system of top-post, three-position, automatic signal is the most recent development of automatic signal devices and is one that is so essentially different from former designs as to force the attention of those directly interested in signal construction and operation. There are several points of design, simplifying the mechanism of this system, one of which is the attachment of the spectacle casting carrying the semaphore blade, directly to the main shaft, which is made possible by locating the apparatus at the top of the pole. Further simple features are seen in the driving and locking details which are shown in Fig 2, representing the mechanism of the top-post three-position signal, the construction being notable for the replacing of sliding and reciprocating parts by revolving and rocking members, with an attendant elimination of frictional resistance.

Figs. 3, 4 and 5 represent the three working positions of the top-post signal, which has a test record of 74,100 movements without renewal of the battery operating it, this result of course being largely due to the freedom of action by the combination of light and strong parts and the direct connection between the motor and shaft, and also by reason that there is no lost work at the motor, since the clutch is devised to produce motion in any position of the mechanism, and the motor therefore takes current from the battery only when overcoming the resistance necessary to move the signal blade. The locking and clutching devices are of the double toggle lever type and absolutely positive in action. The lock magnet and mechanism require but little current to place and hold the signal in clear or caution positions.

Fig. 6 represents the three-position home and distant signals with independent working mechanism, by which the element of reliability is best assured for this type of signal. The mechanism operating the home signal is placed at the top of the pole, and that for the distant signal below and entirely separate from the other. The open doors of the battery housing disclose the batteries in position, also two of the improved double pole relays. Fig. 7 is the two-arm three-position signal of the bottom post type, driven by a single motor, and with locking and clutching details the same as in Fig 6, the operating mechanism being located in the case at bottom of the pole. This arrangement is devised for crossings and junction points. Fig. 8 shows a signal, which also has its mechanism at the bottom of the pole, and is designed for use where, for special reasons, it may be preferred to have the mechanism located below the signal. They are made for either two or three positions. Fig. 9 is a semi-automatic office signal which can be cleared only by an operator, but is thrown to the top position either manually or automatically. It is impossible to clear this signal when its controlling relay is opened by the presence of a train in the block, or any other dangerous combination of circumstances.

The standard double-pole relay shown in Fig. 10 is glass enclosed and has double-break contacts. This relay, having a glass cover bearing on a gasket, is hermetically sealed. The base is made of moulded insulating material, by a process involving a high temperature and immense hydraulic pressure. The studs supporting the contacts are moulded into this material and are therefore permanently and correctly fixed in place. The contacts are of such design as to furnish ample flexibility, and are provided with specially moulded carbon blocks, each of which makes contact with two platinum brushes, by which means they give two breaks in series at each contact. These relays are made with or without back contacts, but whatever the design, they are so constructed that the interior parts cannot be adjusted or moved in any manner without breaking the seal. In addition to this element of safety, they cannot be injured by

for access to the mechanism for inspection of replacement of contacts when necessary. Fig. 13 is an improved switch-box for shunting the relay when the switch is open. This device is made to work either right or left-handed without change, and is provided with a water-tight cover for the protection of its parts.

Fig. 6—Three-position Home and Distant Signals.

Fig. 7—Two-arm Three-position Signal.

Fig. 8—Two-position Bottom-post Signal.

lightning or excessive current, to an extent to cause them to hold the signal clear.

Figs. 11 and 12 represent the company's standard one-arm two-position indicator, front and rear, which is among the line of indicators designed for use in connection with automatic signals. These indicators are made in three forms, the one-arm two-position, the one-arm three-position and the two-arm two-position, for giving both home and distant indications. The working parts of all are similar to those of its signal relays described above. A water-tight door at the back provides

The motors for supplying power to the systems shown are designed to cover all contingencies of service. Fig. 14 shows a type of small direct current generator. Fig. 15 shows one of the standard forms of motor generator sets, while Fig. 16 shows a special motor generator designed for use in charging the signal batteries of one of the most prominent railways. An interesting diagram showing the connections of the three-position automatic block signal for double-track lines is seen in Fig. 17, in which the principle of working of the system may be readily traced.

FIG. 10—STANDARD DOUBLE-POLE RELAY.

FIG. 11—ONE-ARM TWO-POSITION INDICATOR.

FIG. 12—ONE-ARM TWO-POSITION INDICATOR.

FIG. 16—SPECIAL MOTOR GENERATOR ON VERTICAL SHAFT.

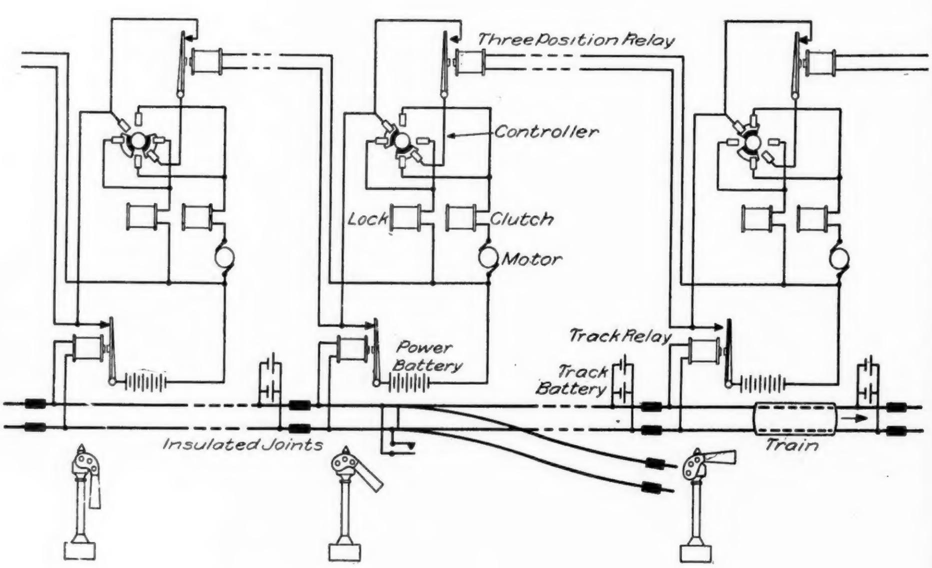


FIG. 17—DIAGRAM SHOWING CONNECTIONS.

FIG. 13—SWITCH BOX.

FIG. 14—STANDARD DIRECT CURRENT GENERATOR.

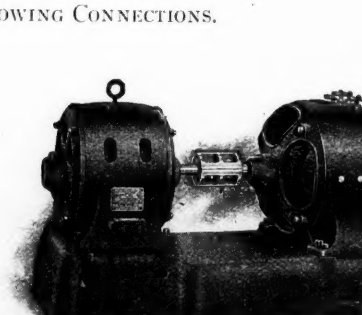


FIG. 15—STANDARD MOTOR GENERATOR SET.

Stereoscopic Vision Applied to Surveying

E. F. NORTHRUP.

Read May 6, 1905, before the Engineers' Club of Philadelphia.

LAST November it was my privilege to meet Dr. Czapski, who is the technical director of the Carl Zeiss works at Jena, and to learn from him of the intensely interesting developments in optics that this noted house has recently been making. Of several strikingly new instruments described, the two that especially interested me are the "Telemeter" and the "Stereocomparator." It is of these that I will give you a very brief description.

Both these instruments make use of, and apply in many useful ways, the power or principle of stereoscopic vision. Few persons who have not given the subject special study realize the remarkable features, the usefulness and power of making accurate measurement, of binocular or stereoscopic vision. If two photographs of an object are taken from slightly different points of view, the two pictures obtained are sufficiently unlike, so that, if by any optical device, it is attempted to blend them together, by superposition or otherwise, the result can only be a blurred and confused image. But put these two unlike photographs in a stereoscope, or any device by which the right eye sees only the one view and the left eye sees only the other, and instantly the two unlike views blend together in the brain, giving the sensation of a clear image, in outline slightly different from either component view, and possessing the additional property of depth or relief. If two diagrams are drawn, one consisting of a circle with a black dot in its center, and the other like it except that the dot is placed slightly out of the center of the circle, and these two diagrams be combined in a stereoscope, it will be observed that in the combined image the dot will appear above or below the plane of the circle. In general, the principle is found to hold in stereoscopic vision, that when two similar views are stereoscopically combined, all relative lateral displacements of objects in the two views in a line joining the oculars produce the physiologic sensation of difference in depth of these objects. Thus, if one view is that of the starry firmament taken at one hour, and the other view is of the same part of the firmament but taken at a later hour after a planet has had time to move slightly relatively to the background of the stars, these two views will combine in a stereoscope, and the image of the planet will appear to stand out in front of and away from the background of the firmament of stars. Surely such a remarkable power of the brain which can combine in its sensorium two unlike images and give a third different from either, must appear quite inexplicable, and as being a gift of nature which may truly be called a sixth sense.

In the telemeter we have a binocular telescope which measures the distance, up to several thousand feet, of any object that comes in the field of view. To accomplish this an ingenious application is made of the principle that lateral displacement in the line joining the eyes of an object in one of two stereoscopic views, produces in the stereoscopic image an apparent displacement in depth of the object so displaced. In each of the eye-pieces of the binocular combination at the plane where the two images of the landscape are formed are two small circles ruled on glass. These two circles appear as one when looking through the binocular glass. By means of a micrometer screw adjustment, the circle in the right-eye tube can be slightly displaced in the line joining the eye-pieces of the telescope. As this displacement is made the little circle appears to move off into space. Its position in space can be perfectly controlled by the screw. To determine, then, the distance to any object in the landscape, it is only necessary to look at it through the binocular telescope and turn the micrometer screw until the ring appears to hang just over the top of the object, and then read off the distance in meters on a scale attached to the controlling screw. Such is the Carl Zeiss telemeter. It is made up in various sizes and adapted to work requiring more or less accuracy. In the largest size, in which by a simple optical device the effective distance between the eyes is increased to about three meters, as much as 3,000 meters can be determined to a precision amounting to 4 per cent, and smaller distances to far greater accuracy. The uses of such an instrument are obvious: such as, finding the range for guns in war or in hunting with a rifle, in rapidly making a quick and preliminary survey of a rough country or a coast line as a boat moves along it, estimating the distance of objects over water, and many other purposes of use and pleasure. Dr. Czapski showed me a small Zeiss field-glass fitted with the telemeter attachment, and I could, with great precision, ease and rapidity, determine the distance of any object within a distance of 300 to 500 meters. I was impressed with the great usefulness which I believe it would have in the hands of surveyors for all kinds of preliminary work. Objects of uncertain outline, as a column of smoke, can be located in reference to distance, in the horizontal or vertical direction, as well as sharply outlined objects, hence the telemeter should prove of use in determining the height of clouds, mists, etc.

But valuable and interesting as is the Zeiss telemeter, the marvel of this optical work is the stereocomparator. This instrument, while embodying in effect all the principles of the telemeter, is designed to make surveys of photographs of a landscape in a manner similar to that which is done with the telemeter on an actual landscape.

The instrument, briefly described, is a very large stereoscope adapted to viewing in detail with considerable magnification or as a whole two photographic positives 13 by 18 centimeters each. By means of lenses and mirrors the effective distance between the eyes is increased to 18 or more centimeters. The frame of the instrument has adjustments for moving the two plates being viewed together in any direction in a plane, and relatively in any direction to each other. The two eye-images are formed each a small scratch on glass. When pieces of the instrument have at the planes where the

looking into the instrument these two scratches, as well as the photographs, combine stereoscopically, and there is seen a mark suspended in place of the landscape. By adjusting various screws, having scales or indices attached, this mark can be moved apparently over the landscape relief view in the three dimensions of space. Like a surveyor's rod, it can be moved about and placed at will wherever desired, the extent of its movements being accurately known by readings given on indicating scales. Hence it becomes possible to make from two carefully and properly taken photographs a complete survey of all the features of a landscape which are visible from two nearby points of view. By taking a number of sets of views from different standpoints the entire contour of the landscape can be surveyed. Methods are available for the conversion of focal co-ordinates, read off on the apparatus into co-ordinates of dimension. Thus drawings can be readily and exactly made at home on the plane table without any calculations whatever, use being made of the stereoscopic relief picture seen in the stereocomparator. The makers of this remarkable apparatus do not claim that the stereocomparator will replace the usual methods of surveying, but that both may be used to the greatest advantage side by side in mutual co-operation. Thus the special usefulness of the stereoscopic method in surveying may be found for the production of most exact topographical plans, the construction of contours, profiles, and models, for the production of plans of inaccessible places, as chasms, mountain heights, and the like. The prospectus published in 1903 in English by Carl Zeiss summarizes the numerous applications of this instrument and methods to other purposes than surveying.

Thus, in stellar astronomy it may be used for the rapid detection and study of any small relative displacement of any of the celestial bodies. In observations on the sun the method is useful for studying the proper movements of sun spots as distinct from their common movement with the rotation of the sun. In observations on the moon the power of the stereocomparator is made marvelously manifest. Two photographs of the moon being taken at different intervals of time give the data for determining the height of the mountains on the moon and the diameter of the craters on its border by means of the traveling index.

The comparator finds also many uses in metronomy for the rapid comparison of scales, spectral lines, and the like. It is useful in meteorology, geology and architecture.

It is regrettable that there is no adequate description in English of this latest and most interesting development of the Carl Zeiss works, but for those that can read German there will be found a most complete and satisfactory discussion of the stereocomparator, and the methods of using it, in a series of articles by Dr. C. Pulfrich in the "Instrumentenkunde" of 1902.

In conclusion, I wish to say that the applications here mentioned of our power of stereoscopic vision are only a few of those which are possible and useful, and I hope at some later date, after completing experiments on which I am at times engaged, to present other interesting and—it is to be hoped—useful facts regarding it.

Personals

Mr. D. Sweeney has been appointed roadmaster of the Missouri, Kansas & Texas at Atoka, I. T., to succeed Mr. Ike Tabler, resigned.

Mr. F. J. Hemphill has been appointed foreman of signals of the Cincinnati, New Orleans & Texas Pacific at Saint Louis, Mo.

Mr. John Hauke has been appointed roadmaster of the Missouri, Kansas & Texas at Atoka, I. T., to succeed Mr. W. S. Van Dorn.

Mr. H. C. Bolenius has been appointed supervisor of the Pennsylvania Railroad at Verona, Pa., vice Mr. J. D. Ferguson, transferred.

Mr. W. S. Ruggles has been appointed assistant engineer of the Oklahoma division of the Atchinson, Topeka & Santa Fe at Arkansas City, Ark.

Mr. J. K. Howard, engineer maintenance of way of the Wabash at Peru, Ind., has been appointed to a similar position on the Chicago, Peoria & St. Louis.

Mr. H. U. Wallace, formerly chief engineer of the Illinois Central, has accepted the position of third vice-president of J. G. White & Co., New York.

Mr. D. M. Case has been appointed superintendent of signals of the Cincinnati, New Orleans & Texas Pacific, with headquarters at Lexington, Ky., vice Mr. W. A. D. Short, resigned.

Mr. C. H. Stein has been appointed supervisor of the main line of the Philadelphia & Reading, from Reading to Philadelphia, Pa, with office at Bridgeport, Pa.

Mr. George F. Syme, heretofore resident engineer of the Coal & Coke Railway at Delta, W. Va., has been appointed resident engineer of the South & Western Railway at Spruce Pine, N. C.

C. B. Keller, supervisor of track of the Cleveland, Cincinnati, Chicago & St. Louis at Connersville, Ind., was killed by a fast freight while riding on a railroad velocipede near Brookville, Ind., on July 10th.

Mr. C. M. James, assistant engineer of the Atlantic Coast Line at Wilmington, N. C., has been appointed acting engineer of roadway of that line at Wilmington, to succeed Mr. George B. Huske, resigned on account of ill health.

Mr. Isham Randolph, chief engineer of the Sanitary District of Chicago, has been appointed a member of the board of consulting engineers of the Panama Canal. He has been granted leave of absence of three months or more to enable him to discharge the duties assigned him by President Roosevelt.

Mr. Louis Larson has been appointed roadmaster of the Chicago, St. Paul, Minneapolis & Omaha at Mankato, Minn., in place of Mr. C. A. Webster, resigned.

Mr. H. W. Parkhurst, who in September, 1904, resigned as engineer of bridges and buildings of the Il-

linois Central on account of ill health, has opened an office at 1643 Monadnock block, Chicago, as consulting engineer for general bridge engineering, with special attention to re-enforced concrete work.

Mr. P. H. Irwin, assistant chief engineer of the Baltimore & Ohio, has been appointed consulting engineer of that road at Zanesville, Ohio, to succeed D. Lee, deceased. Mr. J. E. Greiner, engineer of bridges and buildings, has been appointed assistant chief engineer at Baltimore, to succeed Mr. Irwin.

Mr. George H. Pegram, chief engineer of the Manhattan railway division of the Interborough Rapid Transit Company, has been appointed chief engineer of the Interborough Rapid Transit Co., and of the Rapid Transit Subway Construction Company, succeeding Mr. S. L. F. Deyo.

Mr. R. R. Holland, division engineer of the Southwestern division of the St. Louis & San Francisco at Sapulpa, I. T., has been appointed general roadmaster of the Western division with office at Neodesha, Kan. Mr. Barney Thrall, division roadmaster at Springfield, Mo., has been transferred to Sapulpa, I. T., as general roadmaster of the Southwestern division. sion.

Mr. A. L. Kuehn, engineer of maintenance of way of the Cleveland, Cincinnati, Chicago & St. Louis at Wabash, Ind., has been appointed engineer maintenance of way of the Chicago & Whitewater division, with headquarters at Indianapolis.

Mr. F. G. Jonah, terminal engineer of the New Orleans Terminal Company at New Orleans, La., has been appointed assistant engineer, with headquarters at New Orleans, in charge of the Frisco deep water terminals at Chalmette, succeeding Mr. E. M. Lisle, resigned, effective July 1. Mr. C. H. Fisk has been appointed terminal engineer in place of Mr. Jonah.

Mr. C. G. Delo, heretofore division engineer of the Chicago Great Western at Des Moines, Ia, has been appointed engineer maintenance of way of the western division of the Chicago & Alton, with headquarters at Kansas City, Mo. Mr. W. B. Causey, engineer maintenance of way at Bloomington, will have charge of the western and middle divisions, with headquarters at Bloomington, Ill., as heretofore.

Mr. A. T. Hardin, engineer maintenance of way of the New York Central & Hudson River, has been appointed assistant to the general manager, with headquarters at New York. Mr. George W. Vaughan, division engineer at Buffalo, N. Y., has been appointed to a position on the staff of the chief engineer of New York. Mr. D. L. Sommerville, division engineer of the Pennsylvania division at Jersey Shore, Pa., has been appointed division engineer of the Western division at Buffalo.

Mr. H. T. Douglass, heretofore chief engineer of the West Side Belt, has been appointed consulting engineer of the Wabash lines east of Toledo, O. Mr. E. K. Woodward has been appointed engineer maintenance of way at Peru, Ind., to succeed Mr. J. K. Howard, resigned. Mr. James Stannard has been appointed master carpenter of the St. Louis and Western divisions at Moberly, Mo., in place of Mr. A. C. Blake, who has been appointed foreman of the bridge and building department. The jurisdiction of Mr. A. S. Haynes, roadmaster at Moberly, Mo., has been extended over the car department.

Mr. Edward Shelah, engineer maintenance of way of the Decatur division of the Wabash, has had his jurisdiction extended over the Springfield division. Mr. E. M. Merriweather, heretofore engineer maintenance of way of the Springfield division, has been transferred to the Western and St. Louis divisions, with office at Moberly, Mo., succeeding Mr. W. W. Greenland, and Mr. A. C. Trippeer, both of whom have been appointed assistant engineers maintenance of way, the former under Mr. Merriweather and the latter under Mr. E. K. Woodward, at Detroit, Mich. With these appointments the offices of engineer of maintenance of way at Springfield, Decatur and Moberly are abolished.

Mr. E. A. Handy, chief engineer, has been appointed assistant general manager of the Lake Shore & Michigan Southern, Lake Erie & Western, Indiana, Illinois & Iowa, Lake Erie, Alliance & Wheeling and Dunkirk, Allegheny Valley & Pittsburg, effective on July 15. Officials in charge of the engineering department will report directly to him. Mr. Samuel Rockwell, assistant chief engineer of the Lake Shore & Michigan Southern at Cleveland, Ohio, has been appointed chief engineer of that road and of the Lake Erie, Alliance & Wheeling and Dunkirk, Allegheny Valley & Pittsburg, with headquarters at Cleveland, O., to succeed Mr. Handy. Mr. G. C. Cleveland, assistant chief engineer of the Lake Erie & Western, with headquarters at Indianapolis, Ind., has been appointed assistant chief engineer of the Lake Shore & Michigan Southern, Lake Erie, Alliance & Wheeling and Dunkirk, Allegheny Valley & Pittsburg. Mr. G. P. Smith, engineer of maintenance of way of the Indiana, Illinois & Iowa at Kankakee, Ill., has been appointed chief engineer of that road, with headquarters at Indianapolis, Ind., to succeed Mr. E. A. Handy.

Asphalt Roofing

The remarkable improvement in roofing material in the past few years is to be seen in practically all of the new industrial and railway plants. Time was when a tin roof represented the acme of refinement in roof construction, but oxidation brought on by exposure to the elements gave too short a tenure of life even when well covered by the best protecting pigments. The additional fact that the best roofs were not fire-proof was the incentive for a searching investigation for a material that embodied the qualities of a reasonable price, durability, adaptability to the various requirements of construction, and above all a material that would successfully resist the effects of fire and acids. Many products said to possess these needed points have been brought out, and among them the asphalt roof stands pre-eminent as one that is practically indestructible, besides being a non-conductor of electricity and therefore immune from lightning.

The Stowell asphalt roofing has now been in use fifteen years, and has demonstrated that the cost of maintenance does not enter into a consideration of the question of its

application, since it does not dry out or crystalize, being made of wool felt as a base, which is saturated with Trinidad asphalt. The fire-proofing is dependent on the quality of the roof required. The several products of this house are put out under several well known brands and trade names. The first quality is of high grade wool felt thoroughly saturated and coated with Trinidad asphalt, and then surfaced with a coat of fine feldspar, this vitreous covering being highly ornamental in its luster, as well as fireproof. Another one, having the same base, is covered with a coating of ground slate and mica. A third is surfaced with crushed feldspathic slag. A fourth has a surface of asbestos, while a fifth has a cork surface, and a sixth is composed of two alternating layers, each of Trinidad asphalt and saturated roofing felt, over which is the surfacing of screened gravel. These combinations of felt and asphalt with their mineral armors have met all demands for durability as well as economy, and have, therefore, attracted the attention of the engineer responsible for the installation of shop plants in this country and abroad. The interest of the latter contingent was well shown in the inquiries into the merits of the Stowell roofing by the delegates of the International Railway Congress.

A Rail Loader With Two Booms

The Ft. Worth & Denver City R. R. has recently put into service a new style of machine for loading and unloading rails. It has two booms, so that rails can be handled on both sides of the track simultaneously, and another new feature of the machine is that it is mounted upon a turntable center, so that the booms may be reversed at will, to work either way.

The machine is mounted on a standard-gage truck of four wheels, with a frame of 5-in. I-beams. Thus equipped, it can be used at wrecks for picking up coal, coke, grain, timber, etc., and it can also be used to load coal in storage yards. This flexibility of service therefore renders it a device of exceptional utility. It can also be readily transferred to narrow-gage trucks, if desirable. The boom consists of a 4-in. gas pipe 20 ft. long, but the machine is not limited to short lifts, as it can reach the load no matter wnere located, if within a reasonable distance.

It will be noticed that the source of power is a gasoline engine. At the end of the hoisting cable there is a wooden bar separator 6 ft. long, from each end of which a pair of tongs is slung for grappling with rails. When rails are unloaded from or loaded to flat cars the machine is run over the latter and if closed-end coal cars are to be used trestles of horses are placed in these cars at a height sufficient to run the machine over the closed ends of the cars. A skid is used to run the loader from a flat car to the trestles in the coal cars. By the use of these trestles coal cars are as readily loaded or unloaded as flat cars.

We are informed that this machine nas been doing very satisfactory service. It is operated by six men, and with such a crew it can handle more rails in a given time than a gang of 40 men can do lifting the rails by hand.

Notes of the Month

The company for the mining of the magnesite of Limni, in Evvia, has decided to build an elevated railroad, the rails of which are to be laid on a bed supported by iron pillars. The line will be four miles in length and will extend from the quarries to that point on the seashore to which the product of the quarries is brought down.

U. S. Consul Holloway, of Halifax, reports that the building of the Michigan Central Railway double tunnel under the Detroit River, to cost upward of $10,000,000, will provide an immense amount of work for a foundry plant, and it is likely that a plant costing $500,000 will be a profitable investment. As the tunnel is to be constructed from the Windsor end direct on the Detroit side, it is quite possible that the foundry may be located on the Canada side of the river and built of Canadian material to avoid the duties which would have to be paid on the material if imported from the United States.

The Louisville & Nashville R. R. is planting a forest of 1,400 acres of land, at Carney's, Ala., 30 miles from Mobile, with Catalpa trees for tie timber. The land was previously a pine forest, but most of the pine trees have been removed, and the whole tract will be cleared up. During May 200,000 trees were planted. The ground was plowed and then furrowed out. Fifty men were then employed setting the trees in furrows 7x7 ft. apart. An additional 500 acres of land has been selected in Mississippi, which is now being prepared and will be planted with 1,332,000 trees this season. The company now has 11 groves of timber planted.

The Central Railway station at Antwerp, Belgium, has a tower and dome which are being built of reinforced concrete. The tower springs from the roof of the building at a level of 130 ft. above ground and rises to a height of 130 ft. above this. The reason for selecting reinforced concrete was to reduce the weight in comparison with stone masonry. The dome proper rests upon four large glass lights forming the sides of the square tower. The top part of each of these glass lights is an arch of 32.8 ft. radius, and these arches on the four sides receive the haunches of the dome. The dome consists of two superposed shells, 3.28 to 6.56 ft. apart. The inner shell forms the ceiling of the entrance hall and is decorated with sunken molded panels. The outer shell is 3.15 ins. thick, and is molded on six meridian ribs. All of the moldings and sculptural work of the dome have been formed by direct molding. The weight of the entire structure is 1,800 tons.

The Belmont tunnel, to connect Long Island City with New York, is under way. Work has been started at the Long Island end, operations having been started on a plot of land running from 4th to 5th streets, and between Front street and the West avenue. The property is just across the street from the big power house of the Pennsylvania R. R. The tunnel is to be built under the old Steinway franchise, which provided for the construction of a tunnel from 4th street and Jackson avenue, Long Island City, under 42d street as far west as 11th avenue, New York. The tunnel was started in 1892. A shaft was sunk on 4th street, Long Island City, and in December, 1892, an explosion of dynamite at the mouth of the shaft killed six persons, injuring fifty and destroyed several buildings. The tunnel work stopped, and was never resumed. The Belmont interests secured the franchise and paid off the obligations of the old company, resulting from suits for damages caused by the explosion. The tunnel is to be much like that of the Pennsylvania R. R., having two steel tubes. It will run under the Long Island Railroad freight yard, and have a passenger station in 4th street, between Jackson and Vernon avenues, which is at a point directly opposite the viaduct entrance to the new bridge over Newton creek. There will be two branches to the Long Island Ctiy end of the tunnel. One will go under Newton creek and make a connection with a subway through Greenpoint, and the other will branch off toward the Queens County Court House, where the tunnel will come to the surface and make connections with the tracks of the New York & Queens County Ry.